

Mangrove Forests as Modifiers of the Impacts of Climate Change on High Islands and Atolls in the South Pacific: Mobilizing People and Governments to Act (ATOLLS)

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ABSTRACT

Global climate change could have enormous impact on island environments and the people inhabiting them. Nowhere would the effects of possible rising sea level and increasing storm surges be felt more than on low lying islands called atolls. People of the South Pacific have benefited for centuries from the mangrove resources occurring on many of the atolls. Not only have they benefited directly from the products provided from the mangroves but also indirectly from the protection they have provided against coastal erosion and storms. Conservation and management of the mangrove forest by island nations in the Pacific could reduce the impact of gradually rising sea level and storm surges. Creating public awareness of the importance of mangroves to the island ecosystem; developing strong leadership at the local level to focus local conservation actions; and mobilizing public support for and assistance in these conservation efforts are three critical steps for the planning/management process to be successful. As a starting point this paper describes the development and implementation of a strategy for the island country of Kiribati that could be used as a planning tool for other island countries.

1. INTRODUCTION (ATOLLS)

Atolls are low-lying islands or a series of islands, which surround a lagoon. They are comprised of coralline-based soil, which is characterized by low fertility and poor freshwater retention. There are about 300 atolls in the Pacific Ocean (Liew 1991). Because of their low elevation they are more prone to storm surges and are threatened by rising sea levels expected from global warming. Life is difficult on atolls and the inhabitants share many of the problems as other small islands such as isolation, overpopulation, poor anchorage, and environmental degradation.

Conditions on atolls are commonly more extreme than on the high islands because of greater exposure of plants to salt spray, low rainfall, absence of surface water, and lagoons that are easily polluted. Mangrove forests on high islands are well-developed in deep sediments whereas mangroves on low islands are structurally poorer since they are rooted in shallow sediments (Gillison 1980). Where climate is concerned, the greatest difference between high islands and atolls is their vulnerability to storm surges and rising sea level. (Liew 1991; Thama 1989). Coastal erosion is occurring in many areas in spite of man-made barriers constructed to reduce the action of the waves. Many atolls have already suffered the destructive forces of storm surges.

Should global warming cause sea levels to rise, and the frequency of storm surges to increase, the atoll people of the South Pacific will have to endure possible severe consequences including loss of their homes. In a report prepared by the South Pacific Regional Environmental Programme "global warming and sea level rise are acknowledged as the most serious environmental threats to the Pacific region" (SPREP 1992). The degree of impact will depend on the rate that the sea rises, the size and frequency of storm surges, and, to a certain extent, the preparations made by the people inhabiting the atolls. Under a worst-case scenario, the people

will eventually have to abandon the islands and be resettled by reason of dwindling resources and the danger of inundation (Newell and Conrad 1990).

For hundreds or even thousands of years people of the South Pacific have depended on mangrove resources to sustain subsistence lifestyles on the atolls. Like many other people around the world they appreciated the direct products mangroves provided like fuel, timber for poles and lumber, bark for tannin dyes, fish stakes, etc. Although the products provided by the mangroves have always been important, other indirect benefits of mangroves such as providing breeding grounds for marine life, providing areas of biodiversity, land building, and especially protection of the shoreline from erosion due to wave action, storm surges and strong winds have been only recently understood.

The value of mangroves for reducing shoreline erosion is well documented in many parts of the world (FAO 1994 and 1995; Devoe 1993; Gillie 1992; Hamilton, et al. 1984). Saenger, et al. (1983) points out that although storms may batter and damage mangroves, the forests are capable of repairing themselves naturally; something that no human engineered barrier is able to do. Roth (1997) acknowledges the benefits of mangroves for protection of coastlines but also points out the threat to the mangrove ecosystem from storms, which are expected to increase in frequency and severity. Rising sea levels may have an impact on the mangrove ecosystem, but it may be difficult to differentiate the changes from other causes (Kjerfve and Macintosh 1996). For example, minor changes in the ecological conditions could weaken them and render the trees more susceptible to forest insect and disease pests that normally would not attack healthy mangroves. The United Nations has established a Mangrove Task Team to assess the impact of climate change on mangrove ecosystems as part of the Coastal Marine Programme and the United Nations Environmental Programme (UNEP/UNESCO 1992).

On some islands in recent years, mangrove resources have suffered due to development associated with urbanization, industrialization, construction of causeways, fishpond construction and land reclamation. Development projects in small island nations are very important to improve the economic status of the people and to bring in much needed foreign currency. For this reason appreciation of the mangroves by the indigenous people may not appear to be as great today as in the early days because imported goods have replaced products formerly derived from the mangrove forests. However, the value of mangroves for protection of the coastline cannot be ignored in view of the threats posed by rising sea levels. There is already evidence that the destruction of mangroves is followed by erosion of the land they once protected.

1.1 Indicators of Climate Change in Pacific Islands:

The occurrence of global warming is still controversial. Scientist in various organizations and agencies around the world are monitoring various indicators to determine if there are long-term trends confirming this phenomena. Some of the possible indicators of real problems in the ocean environment could include the following:

- Sea level rise
- Rise in carbon dioxide concentration in the atmosphere
- Increasing storm frequency and intensity
- Severe droughts caused by El Nino and Southern Oscillation
- Increasing sea temperatures

1.2 Problems posed for islands

Although all areas of the earth would experience the impact of global warming, if it occurs, the problems could be compounded in island environments. Specific impacts of global warming on forests and trees on Pacific Islands are discussed in Newell and Conrad (1990) and SPREP (1992). Some of the problems resulting from these phenomena may include:

- Shoreline erosion; direct impact for people living along the shoreline, indirect impact for those away from shore
- Human alteration of shorelines (sea walls, groins, re-routing rivers etc.)
- Increasingly destructive wave activity and decreased protection from submerged offshore reefs
- Loss of biodiversity in mangroves and other indigenous forests
- Adverse impact of rising sea level and storm surges on the mangrove forest
- Probable decline in fisheries and other marine life
- Loss of cooling from transpiration and shade
- Increased saltwater incursion and storm overwash into freshwater lenses, and agricultural areas.
- Loss of nutrients washed into lagoon and reef
- Loss of agricultural areas and fuelwood resource caused by flooding and salt spray
- loss of seagrass beds
- increased coral mortality
- loss of property and structures
- Others

2.0 RESPONSES TO PROBLEMS POSED BY CLIMATE CHANGE (Kiribati)

2.1 National Environmental Management Strategy (NEMS):

The South Pacific Regional Environment Programme (SPREP), in cooperation with the government of Kiribati, produced a National Environmental Management Strategy in 1993. The strategy included establishing or restoring coastal vegetation to reduce the impact of global warming and specifically outlined the research needed for the conservation and management of the mangrove ecosystem for protection of the coastline from rising sea levels (SPREP 1993).

2.2 Pacific Regional Environmental Programme South Pacific Applied Geoscience Commission (SOPAC)

The protection of coastal areas from erosion in the South Pacific Island countries has been stated as fundamental to economic development. Activities identified in the SOPAC strategic plan include:

- Resource studies for environmental management and coastal development
- Assessment of wave energy
- Coastal monitoring
- Process studies
- Management advice
- Coastal protection as relates to mangroves
- Provide regional information on climate variations and sea level changes

2.3 Pacific Islands Forest & Trees Support Programme and USDA Forest Service

The Pacific Islands Forests and Trees Support Programme (PIF&TSP) was established by FAO/UNDP "to assist island developing countries to strengthen national and community capacities in the use, management, conservation and development of their forest and tree resources on a sound and sustainable basis.

Work supported by this Programme has included reviews of national policies and legislation pertaining to the environment or forestry in Pacific Island Countries and the development of management plans for the conservation and management of mangroves. The experiences gained from this programme could be used to develop a strategy for other small island and atoll countries.

The USDA Forest Service through the Institute of Pacific Islands Forestry based in Honolulu, Hawaii, has provided assistance to PIF & TSP by supplying consultants and technical support and funding and conducting research where information gaps exist.

Studies in Kiribati

The island country of Kiribati is a chain of 33 small coral atolls in the central Pacific Ocean and has a land area of about 719 square kilometers scattered over two million square miles of ocean. Atoll elevations range from sea level to about 3.0 meters. Atoll interiors consist of raised ramparts formed by coral fragments. Coastal areas are generally formed by islets encircling sheltered lagoons.

The possible impact of global warming is of much concern to the people and government in this island country. Although there is little information on how global warming will alter the atolls of Kiribati, the Inter-Government Panel on Climate Change (IPCC) predicts a 25.0-30.0 cm rise in sea level by the year 2050. Coupled with global warming, this could lead to a 50.0 cm increase in the sea level by the year 2100 (Koop, 1995).

In 1995 the South Pacific Forestry Development Programme and the USDA Forest Service provided a consultant to assist the government of Kiribati which is the world's largest atoll country to conduct an assessment of mangrove resources on four atolls. The purpose was to determine the general distribution, composition, and level of use of the mangroves by the people and to work with the government of Kiribati developing a management strategy for conservation and management.

During the study a total of 258 hectares of mangroves were found on the four atolls (Butaritari - 166, Tarawa 57, Aranuka - 14, and Maiana - 21 hectares). Species found included *Rhizophora stylosa*, *Bruguiera gymnorhiza*, *Sonneratia alba* and *Lumnitzera littorea*. They ranged in size from shrubs to trees up to 20 meters high and were typically found along shorelines of sheltered lagoons where they form a narrow fringe predisposed to diurnal tidal inundation.

Traditionally the mangroves on these islands have been used for fuelwood, structural materials, posts and poles, seaweed cultivation, fishtrap stakes, dyes for preserving and coloring canoe sails and clothing, leaves and flowers for garlands and leis, and scent for coconut oil. The need for some of these products has declined on some of the islands due to the increased availability of imported goods.

During the assessment, several factors were causing a reduction in the area of the mangrove wetlands in Kiribati. The greatest impact was due to development projects such as reclamation activities, fish pond construction and inter-islet causeways. The removal of mangroves in some areas had obviously increased the likelihood for coastal erosion. The current rate of harvest for traditional products appeared to be sustainable with a future possibility for some commercial utilization if the mangroves were managed properly. However, continued development without regard to maintaining the mangroves could result in a drastic decline in the volume and availability of this resource.

The study concluded that the mangroves of Kiribati provided the people with invaluable ecological, social and economic benefits. Conservation of the mangrove wetlands was considered of tremendous importance for protecting the country's island ecosystem and the Kiribatian quality of life.

Based on the information obtained in this study a proposed management and conservation plan called the Kiribati Mangrove Management Plan (KMMP) was developed for the mangroves. The plan presented management options for specific areas of mangrove to serve as a guide for the government of Kiribati.

Implementation of the Management Plan

Two years after the initial study and development of a management plan, no action had been taken because of a lack of funds and shortage of available personnel. In 1997, at the request of the government of Kiribati, another consultant was provided by the South Pacific Commission's Pacific Islands Forest & Trees Support Programme and the USDA Forest Service's Institute of Tropical Islands Forestry. The mission of the consultant was to work with the government of Kiribati's Division of Agriculture and Ministry of Natural Resource Development to prepare an Implementation Plan for the Conservation and Management of the Mangroves and to implement activities outlined in the management plan. The following activities were implemented:

- Interviews were held with individual agencies, institutions and NGO's that were expected to have some interest in mangroves or coastal development
- Newspaper article was written and published to create awareness concerning the mangroves
- Fact Sheet was prepared on mangroves of Kiribati to create awareness
- Mangrove management committee formed
- Presentation was made by Agroforestry Section to stimulate awareness for mangroves
- Brochure published by the Environment Unit in local language on mangroves
- Implementation Plan and program of work for mangroves was prepared
- Project document for mangrove management was prepared to submit to a donor for funding
- The Environment Bill, which provided a legal basis for conservation and management of the mangroves, was prepared by the Environment Unit and submitted to government

3. DISCUSSION AND CONCLUSIONS

Conservation and management of mangroves on small island nations should be a priority of natural resource managers regardless of the threat posed by global warming. Considering the value of mangroves for reducing coastal erosion and all the other benefits described earlier, it is

urgent that management strategies be developed for the island nations of the South Pacific to conserve, protect and restore mangroves. The urgency for action may be compounded since global warming is also expected to have an adverse impact on the health and existence of mangroves around the world. Recommendations for conservation and management of mangroves are available from numerous sources including FAO and IUCN. Lal (1991) summarizes management strategies implemented on several Pacific islands and provides a model for an integrated approach to wetland resource allocation and management. Recent experiences in Kiribati and other island nations have provided some guidelines that can be used to develop management strategies in other small island or atoll countries.

The major problem that exists today in the South Pacific island countries is not what to do but how to mobilize people and government agencies to act. Even if manpower and funds are not readily available there are many activities that could be initiated by government agencies responsible for forestry, agriculture, environment and coastal protection. Leadership is the most valuable service government agencies can contribute.

As observed on Kiribati, there is a great interest in the possible impact of global warming and the role mangroves can play. Other government agencies, NGO's, educational institutions and local communities have shown concern in conservation of the mangroves. Some of these institutions and agencies have small amounts of funds that could be allocated for this purpose. Unfortunately, forestry is not an important sector in many island countries because there are other sectors such as agriculture, commerce, healthcare that demand more immediate attention (Desloges, 1995). However, forestry agencies can make an important contribution by providing strong leadership and bringing together agencies, institutions and NGO's from other sectors to assure an integrated approach to manage the mangroves.

3.1 Suggested guidelines for development of a management strategy for small island nations with mangroves.

Based on the experience gained on Kiribati and information published in several publications and management handbooks, the following general guidelines can assist in developing a strategy for conservation and management of mangroves for small island nations:

- Use an integrated approach with other sectors including agriculture, fisheries, transportation and coastal development programs;
- Conduct an inventory of mangrove forests and tree and associated resources;
- Consult with people on the current uses of the resources;
- Evaluate the role and attitudes concerning mangroves as perceived by national and regional ;
- Establish a legal basis for conservation and management of the mangrove resource (such as the Environment Bill in Kiribati);
- Designate a government agency to be responsible for managing mangroves;
- Organize a mangrove management committee comprised of government agencies, NGO's, local government leaders and community leaders;
- Assign land classification classes to assist in management of the resource;
- Create awareness on the importance of mangroves through the use of local media, community activities and educational institutions;
- Develop site-specific plans for the mangroves with participation of the mangrove management committee and local communities
- Develop and recommend specific research projects to fill information gaps;

- Mobilize resources to execute the plans employing local and outside sources

3.2 Implementation of specific activities to promote conservation and management of mangroves for reducing the impact of global warming could also include:

- Work closely with local, national, and regional planning and development agencies to reduce the impact of their activities on the mangrove resource;
- Encourage the preparation of environmental assessments for development projects showing potential benefits or adverse impacts on the mangroves;
- Develop a mangrove restoration program;
- Get local communities involved in planting mangroves;
- Determine specific sites for restoration or establishment on new sites suitable for mangrove trees; and
- Provide training opportunities in management of mangroves to professional and technical staff.

In summary, mangroves may not be the total answer for eliminating the impact of climate changes in the South Pacific but their conservation and proper management can reduce the impact of rising sea levels and storm surges on small islands in the South Pacific. In addition mangroves can continue to provide the products and benefits as they have since the islands were inhabited. The most important role for forestry and agroforestry agencies in small island and atoll countries is to provide strong leadership to bring together agencies and organization from all sectors, create public awareness of the importance of the mangroves and assist in mobilizing both human and financial resources to promote an integrated approach to manage the mangrove resource.

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